UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

MAR 8 1989

OFFICE OF
PESTICIDES AND TOXIC SUBSTANCES

MEMORANDUM

SUBJECT: SIMAZINE Second Round Review (SRR)

FROM: James W. Akerman, Chief
Ecological Effects Branch
Environmental Fate and Effects Division (H7507C)

TO: Christine Dively
Special Review and Reregistration Division (H7508C)

Attached to this cover memorandum are the Topical Summaries, Disciplinary Review and Generic Data Requirements for the Ecological Effects Branch Chapter of the Simazine SRR.

cc: Carol Stangel, SPSMS (memorandum only)
Esther Saito, SIPS coordinator

SIMAZINE 080807

Ecological Effects Chapter

INTRODUCTION

The Ecological Effects Chapter for the initial Simazine Science Chapter identified two outstanding data requirements, an avian reproduction test with an upland gamebird and a coldwater fish acute toxicity test with a typical end-use product. Studies to fulfill these requirements have been accepted. Subsequent to issuance of the Simazine Registration Standard (March 1984) the regulations for data requirements of pesticides were issued (40 CFR Part 158, November 1984). In accordance with these regulations, additional data are required for support of the simazine registration. Also, certain tests accepted in the earlier standard review have been found to be deficient in this review and will have to be upgraded. Tests requiring replacement include an avian reproduction study with waterfowl, an estuarine mollusc acute test and and estuarine fish acute test. Data newly required by this Second Round Review as a result of an assessment of available information and promulgation of the regulations for data requirements include an aquatic field study and Tier II phytotoxicity tests for non-target plants.

TOPICAL SUMMARIES

Effects on Birds

Eleven studies in seven citations have been evaluated under this topic. These studies were used in performing a hazard assessment.

Author	MRID#
Beavers & Breslin	163134
Beliles et al.	0043671
Beliles et al.	0043672
Fink	0043672
Fink	0072798
Gough & Shellenberger	~~0070001~~ 00139393
Hill et al.	~~0034769~~ 00022923

In order to establish the toxicity of simazine to birds, the minimum data required on the technical material are:

- An avian single-dose LD50 test with either one species of waterfowl, preferably the mallard, or one species of upland gamebird, preferably bobwhite (section 71-1); and

- Two avian dietary LC50 tests, one with a species of waterfowl, preferably the mallard, and one with a species of upland gamebird, preferably the bobwhite (section 71-2).

Avian Acute Oral Toxicity - Technical

An acceptable acute oral toxicity studies on simazine is listed below.

Species	Test Material	Results	Author	Date	MRID	Fulfills Req.
Mallard	Tech.	LD50=4640 mg/kg	Fink	1976	0072798	yes

Avian Dietary Toxicity - Technical

The acceptable avian dietary toxicity studies on technical simazine are listed below.

Species	Test Material	Results	Author	Date	MRID	Fulfills Req.
Bobwhite	98.9%	LC50>20,000 ppm	Gough & Shellenberger	1972	00139393 ~~0070001~~	yes
Bobwhite	98.9%	LC50>2000 ppm (11 week)	Gough & Shellenberger	1972	00139393 ~~0070001~~	no[1/]
Bobwhite	99.1%	LC50>5000 ppm	Hill et al.	1975	00022923 ~~0034796~~	yes
Japanese quail	99.1%	LC50>3720 ppm	Hill et al.	1975	00022923 ~~0034796~~	no[2/]
Ring-necked pheasant	99.1%	LC50>5000 ppm	Hill et al.	1975	00022923 ~~0034796~~	yes
Mallard	99.1%	LC50>5000 ppm	Hill et al.	1975	00022923 ~~0034796~~	yes

new numbers MA 1/23/90

[1/] Extended exposure period and a maximum test concentration below accepted minimum of 5000 ppm.

[2/] Not a recommended test species.

The guideline requirements for acute avian toxicity testing have been fulfilled. These test results show that simazine is practically non-toxic to birds.

Avian Dietary Toxicity - Formulated Product

The acceptable avian dietary toxicity studies on formulated simazine are listed below.

Species	Test Material	Results	Author	Date	MRID	Fulfills Req.
Bobwhite	80% WP	LC50=11,000 ppm	Beliles et al.	1965	0043671	no[3/]
Mallard	80% WP	LC50>32,000 ppm	Beliles et al.	1965	0043671	no[4/]

[3/] Birds were older than recommended age.

[4/] Birds were younger than the recommended age.

Avian Reproduction Studies - Technical Simazine

Avian reproduction studies may be required (section 71-4) for pesticides which are stable in the environment to the extent that potentially toxic amounts may persist in avian feed. Simazine may persist in the environment (up to 40 days in soil, up to 700 days in water) and therefore subject birds to repeated and/or continuous exposure.

The acceptable avian reproduction toxicity studies on technical simazine are listed below.

Species	Test Material	Results	Author	Date	MRID	Fulfills Req.
Mallard	99.1%	NOEL>20 ppm	Fink	1974	0043678	no[5/]
Bobwhite	97.0%	NOEL=100 ppm LOEL=500 ppm	Beavers & Breslin	1986	163134	yes

5/ The maximum test concentration is below concentrations reasonably anticipated on waterfowl foodstuffs.

The guideline requirements for chronic avian toxicity testing have been fulfilled only for upland gamebirds, the requirement for waterfowl has not been satisfied. The NOEL is based on no observation of effect to body weight, food consumption, eggs laid, eggs cracked, viable embryos, live three-week embryos, normal hatchlings, 14-day old survivors and eggshell thickness. The LOEL for bobwhite is based on an observed reduction in number of eggs laid.

Field Testing

Avian field testing may be required depending on the results of the avian toxicity studies and available fate and exposure information. Also, though unusual and rare, field testing may be required if toxicity information on other organisms and related fate and exposure information indicate that indirect effects to birds may be expected. No requirements for avian field testing are imposed at this time.

Precautionary Labeling

Based on the available information, no toxicity labeling for birds is needed.

Effects on Freshwater Fish

Twelve studies in ten citations have been evaluated under this topic. These studies were used in performing a hazard assessment.

Author	MRID#
Beliles et al.	00025438
Bowman	40245701
Gilderhus	00025433
Kuc	00043666
Kuc	163136
Mayer & Sanders	00043676
Sleight	00033309
Swabey & Schenk	00034214
Thompson & Forbis	163135
Zak et al.	00043668

✓ Fish Acute Toxicity Tests - Technical

The minimum data required for establishing the acute toxicity of simazine to fish are the results from two 96-hour studies with the technical product. One with coldwater species, preferably rainbow trout, the other with a warm water species, preferably bluegill sunfish (section 72-1). The acceptable fish studies are listed below.

Species	Test Material	Results	Author	Date	MRID	Fulfills Req.
Rainbow trout	Tech.	LC50=70.5 ppm	Kuc	1976	0043666	yes
Bluegill sunfish	99.1%	LC50=16 ppm	Beliles	1965	0025438	yes
Fathead minnow	Tech.	LC50=6.4 ppm	Sleight	1971	0033309	yes
Rainbow trout	97.6%	LC50>10 ppm	Thompson & Forbis	1983	163135	no[1/]

1/ The study did not expose animals to a maximum recommended test concentration of 100 ppm or demonstrate that a maximum solubility/dispersion concentration was achieved.

These studies fulfill the guideline requirement for fish acute toxicity tests for simazine with technical material. They show that technical simazine is moderately toxic to finfish in acute exposures.

Fish Acute Toxicity Tests - Formulated Product

Data on the acute toxicity of formulated products of simazine to fish are required for uses with direct application to water. Two studies are minimally required for fulfillment of formulated product testing, one with coldwater species, preferably rainbow trout, the other with a warm water species, preferably bluegill sunfish (section 72-1). The acceptable fish studies are listed below.

Species	Test Material	Results	Author	Date	MRID	Fulfills Req.
Rainbow trout	80% WP	LC50>82 ppm	Bowman	1987	40245701	yes
Rainbow trout	80% WP	LC50=60 ppm (7^{o} C) LC50=40.5 ppm (12^{o} C) LC50=44.6 ppm (17^{o} C)	Kuc	1976	163136	no[2/]
Emerald shiner	50%	LC50>18ppm	Swabey & Schenk	1963	0034214	no[3/]

2/ Test material precipitated in test solutions with no verification of exposure concentrations.

3/ Not a recommended test species and maximum test concentration below accepted level.

These studies fulfill the guideline requirement for fish acute toxicity tests for simazine with formuated product. They show that formulated simazine is moderately toxic to finfish in acute exposures.

Fish Early Life Stage/Reproductive Tests

Fish chronic toxicity studies may be required (section 72.5). Simazine is expected to persist in water with a 1/2- life from 50 to 700 days, therefore, a fish chronic toxicity study is required. The acceptable fish chronic studies are listed below.

Species	Test Material	Results	Author	Date	MRID	Fulfills Req.
Rainbow trout	Tech.	28-day LC50 > 2.5 ppm	Zak	1973	00043668	no[4/]
Fathead minnow	80% WP	NOEL=1.2 ppm LOEL=2.5 ppm	Mayer & Sanders	1975	00043676	no[5/]

4/ Test unable to identify a No Observable Effect Concentration.

5/ Use of formulated material and failure to report measured concentration values.

The guideline requirements for finfish chronic toxicity testing have been fulfilled by the combination of the above tests. The NOEL for fathead minnow is based on no observation of effect to spawning, hatching, larval/fry growth and survival. The LOEL for fathead minnow is based on an observed reduction in fry growth.

Field Studies

Field studies may also be required to determine exposure or effects to finfish (section 72-7). Aquatic field testing may be required depending on the results of laboratory toxicity studies and available fate and exposure information. Also, though unusual and rare, field testing may be required if toxicity information on other organisms and related fate and exposure information indicate that indirect effects to finfish may be expected.

A simulated field study by Gilderhus (1967, 00025433) shows that at < 5 ppm simazine is effective for control of Elodea canadensis. The study was conducted in nine 0.01-acre concrete ponds filled with Mississippi River water. Each pond had 4 inches of loam on the bottom and was initially stocked with Elodea. A total of 150 bluegill and 150 goldfish were placed in each pond.

Three ponds were untreated and served as controls, three were treated once with 1, 2.5 and 5 ppm, respectively, and the remaining three were treated with 1, 2.5 and 5 ppm, respectively, every 4 weeks for a total of 5 treatments each. The 5 ppm concentration did not reduce survival of goldfish during the study, but it did reduce survival of bluegill. Fish survival during the study was not reduced at 2.5 ppm for either species. Some physiological stress was observed. Goldfish and bluegills from pools treated monthly were subjected to histopathological examination at 5, 10 and 20 weeks after treatment. Goldfish at all concentrations with repeated treatments had lifted lamellar epithelium and edematous lamellae in the gills. Those exposed to repeated treatments of 2.5 and 5 ppm showed ulceration of the gastric mucosa and after 20 weeks those exposed to 5 ppm developed liver damage. This study is not considered adequate to fulfill the guideline requirement for aquatic field testing, if imposed.

No requirements for aquatic field testing with finfish are imposed at this time.

Precautionary Labeling

Based on the available information, no toxicity labeling for fish is needed.

Effects on Aquatic Invertebrates

Nine studies in four citations have been reviewed and used to perform a risk assessment on aquatic invertebrates.

Author	MRID#
Gilderhus	00025433
Mayer & Sanders	00043676
Mayer & Ellersieck	40098001
Walker	RI0SIM01

Aquatic Invertebrate Acute Toxicity Tests - Technical

The minimum data requirement for establishing the acute toxicity of simazine to aquatic invertebrates is the result from one 48-hour (or 96-hour) acute toxicity test with the technical product (section 72-2). Acceptable tests are listed below.

Species	Test Material	Results	Author	Date	MRID	Fulfills Req.
Daphnia magna	98.1%	EC50>10 ppm 48hr	Mayer & Ellersieck	1986	40098001	no[1/]
Cypridopsis vidua	98.1%	LC50=3.7 ppm 48hr	"	"		yes
Gammarus fasciatus	98.1%	LC50=130 ppm 96hr	"	"		yes
Palaemonetes kadiakensis	98.1%	LC50>5.6 ppm 24hr	"	"		yes
Pteronarcys californica	98.1%	LC50=1.9 ppm 96hr	"	"		yes

[1/] Test concentration below maximum accepted test concentration.

These studies fulfill the requirements for an acute toxicity testing with aquatic invertebrates and shows that technical simazine is moderately toxic to this group in acute exposures.

✓ Aquatic Invertebrate Acute Toxicity Tests - Formulated Product

Data on the acute toxicity of formulated products of simazine to aquatic invertebrates are required for uses with direct application to water. The acceptable aquatic invertebrate studies are listed below.

Species	Test Material	Results	Author	Date	MRID	Fulfills Req.
Daphnia magna	80% WP 48hr	EC50>10 ppm	Mayer & Ellersieck	1986	40098001	no[2/]

[2/] Maximum test concentration below maximum accepted test concentration.

This study fulfills the guideline requirement for aquatic invertebrate acute toxicity testing for formulated simazine when combined with the chronic daphnid test performed with formulated product (Mayer and Sanders, 1975). Acceptable aquatic invertebrate This study shows that formulated simazine is moderately toxic to aquatic invertebrates in acute exposures.

✓ Reproductive Aquatic Invertebrate Testing

Reproductive testing with aquatic invertebrates may be required (section 72-4). Since simazine is registered for major outdoor uses (forests, corn, alfalfa, ponds, etc.) and persistent in water (1/2-life from 50 to 700 days) aquatic invertebrate reproductive testing is required. Acceptable aquatic invertebrate toxicity tests are listed below.

Species	Test Material	Results	Author	Date	MRID	Fulfills Req.
Daphnia magna	80% WP	NOEL=2.5 ppm	Mayer & Sanders	1975	0043676	no[3/]
Benthic organisms	Tech.	NOEL>10 ppm < 20 ppm	Walker	1964	RIOSIM01	no[4/]

[3/] Test material was formulated product.

[4/] Test methods (scope) insufficient to fulfill a full-scale aquatic field test.

In Walker (1964, RIOSIM01), waterbugs, mayfly nymphs, horsefly larvae, common midges, mosquitoes, phantom midges, biting midges, caddisfly larvae, dragonfly nymphs, damsel fly nymphs, water beetles, aquatic worms, leeches, clams and snails found in natural mud samples were submerged in buttertubs. Concentrations of 10 ppm resulted in little more mortality that the controls. This does not meet any guideling requirement because it is not a standard protocol.

Field Studies

Field studies may also be required to determine exposure or effects to aquatic invertebrates (section 72-7). Aquatic field testing may be required depending on the results of laboratory toxicity studies and available fate and exposure information. Also, though unusual and rare, field testing may be required if toxicity information on other organisms and related fate and exposure information indicate that indirect effects to aquatic invertebrates may be expected.

A simulated field study by Gilderhus (1967, 00025433) shows that at < 5 ppm simazine is effective for control of Elodea canadensis. The study was conducted in nine 0.01-acre concrete ponds filled with Mississippi River water. Each pond had 4 inches of loam on the bottom and was initially stocked with Elodea. A total of 150 bluegill and 150 goldfish were placed in each pond. Three ponds were untreated and served as controls, three were treated once with 1, 2.5 and 5 ppm, respectively, and the remaining three were treated with 1, 2.5 and 5 ppm, respectively, every 4 weeks for a total of 5 treatments each.
The total production of zooplankton over the 5-month test was similar in all ponds. The bottom fauna populations in the controls, 1 ppm yearly and 1 ppm monthly, were similar. Their mean number of organisms per square foot and the peak populatios were nearly identical, revealing no effect of simazine. The 2.5 and 5 ppm yearly and monthly treatments appeared to suppress bottom fauna for 2 or 3 weeks following treatments but then those ponds developed populations which were far in excess of those in controls or the 1 ppm concentrations. The researcher concluded that the temporary reductions were due to oxygen depletion due to destruction of the vegetation. Whether this conclusion is correct or not, the study does show that concentrations of simazine which control vegetation do not totally eliminate all benthic fauna. However, no information was provided on species diversity, so the study does not unequivocally show that simazine did not affect aquatic invertebrates. This study alone would not fulfill the requirement for a aquatic field test.

Such testing is reserved pending receipt of outstanding aquatic organism testing and environmental fate information.

Precautionary Labeling

Based on the available information, no toxicity labeling for aquatic invertebrates is needed.

√ Effects on Estuarine and Marine Organisms

Four studies in three citations were reviewed and used to perform the hazard assessment on marine and estuarine organisms.

Author	MRID#
Cook and Smith	00043667
Sleight and Macek	00023331
Wright and Beliles	00043677

√ Acute Toxicity Tests - Technical

Toxicity testing with estuarine and marine organisms may be requested (section 72-3). The requirements under this category include a 96-hour LC50 for an estuarine fish, a 96-hour LC50 for a crustacean and either a 48-hour embryo-larvae study or a 96- hour shell deposition study with oysters. The following studies are acceptable.

Species	Test Material	Results	Author	Date	MRID	Fulfills Req.
Eastern oyster	99.1%	96hrEC50>1 ppm	Wright & Beliles	1966	00043677	no[1/]
Pink shrimp	98.9%	96hrLC50=113ppm	Sleight & Macek	1973	00023331	yes
Mud crab	"	96-hr LC50>1000ppm	"	"	"	no[2/]

[1/] Maximum test concentration below maximum accepted test concentration.

[2/] Test organism not a recommended species.

These data fulfill the requirements for estuarine/marine crustacean testing. They demonstrate that simazine is moderately toxic to crustaceans. They tentatively demonstrate that simazine is moderately toxic to molluscs. These data do not satisfy the requirements for estuarine/marine testing with molluscs and fish.

X Acute Toxicity Tests - Formulated Product

Data on the acute toxicity of formulated products of simazine to estuarine/marine organisms may be required for uses with direct application to estuarine water, certain uses of simazine (e.g., rights-of way) could be construed to meet this requirement, but

such direct exposure occurrences would be expected to be minimal and no requirement is imposed for formulated testing. Nonetheless, an acceptable fish study is listed below.

Species	Test Material	Results	Author	Date	MRID	Fulfills Req.
Striped bass	80% WP	96hrNOEL=3 ppm	Cook & Smith	1967	00043677	no[1/]

[1/] Maximum test concentration below maximum accepted test concentration.

This study is not considered adequate to fulfill a formulated product test requirement if one were imposed.

Precautionary Labeling

Based on the available information, no toxicity labeling for estuarine and marine organisms is needed.

Effects on Non-target Plants

No studies were received under this topic. To determine toxicity of simazine to non-target plants, the following studies are required:

123-1: Seed germination/seedling emergence and Vegetative Vigor;
123-2: Aquatic plant growth.

These tests are required for terrestrial and aquatic non- food uses including forests, rights-of-way, ditchbanks, etc.

Higher tier testing may be required depending on the results of the lower tier tests.

Effects on Beneficial Insects

The following study was received and reviewed under this topic.

Author	MRID#
Atkins et al.	00036935

Species	Test Material	Results	Author	Date	MRID	Fulfills Req.
Honey bee	Tech.	At 96.69 ug/bee mortality was 6.52% (relatively nontoxic)	Atkins et al.	1975	00036935	yes

There is sufficient information to charaterize simazine as relatively nontoxic to honey bees.

DISCIPLINARY REVIEW

I Ecological Effects Profile

A Technical Simazine

1. Avian Studies

Three studies show that simazine is practically nontoxic to birds in acute or subchronic exposures. An acute oral study (Fink, 1976, 00072798) resulted in an LD50 > 4640 mg/kg for mallard duck. Avian dietary studies (Hill et al., 1975, 00034796) demonstrate an LC50 of >5000 ppm for both mallards and bobwhite quail.

The chronic toxicity of simazine to upland gamebirds can be characterized by an avian reproduction test (Beavers and Breslin, 1986, 163134) which demonstrates a reduction in eggs laid to bobwhite quail exposed to 500 ppm. No effect to body weight, food consumption, eggs laid, eggs cracked, viable embryos, live three-week embryos, normal hatchlings, 14-day old survivors and eggshell thickness. A study with mallards (Fink, 1974, 0043678) tested simazine only up to 20 ppm, but demonstrated no observed effects at this concentration.

2. Aquatic Studies

Simazine has been demonstrated to be moderately toxic to finfish with a 96-hr LC50 of 6.4 ppm to the fathead minnow, 16 ppm to the bluegill, and 70.5 ppm to the rainbow trout (Sleight, 1971, 00033309; Beliles, 1965, 00025438; and Kuc, 1976, 00043666, respectively). A 28-day test with rainbow trout (Zak, 1973, 00043668) reveals an LC50 of > 2.5 ppm.

Mayer and Ellersieck (1986) reports a 48hr EC50 of greater than 10 ppm to Daphnia magna and a 96hr LC50 of 1.9 ppm to Pteronarcys californica which characterizes simazine as moderately toxic to aquatic invertebrates in acute exposures.

3. Estuarine Studies

Sleight and Macek (1973, 0002331) report a 96-hr LC50 of 113 ppm to pink shrimp and Wright and Beliles (1966, 00043677) report a 96-hr EC50 for shell deposition of greater than 1 ppm which characterizes simazine as moderately toxic to estuarine molluscs and practically nontoxic to estuarine crustaceans.

B Formulated Product Testing

Simazine toxicity of formulated products to non-target fish and wildlife has been assessed by a variety of tests with the 80% active ingredient wettable powder.

1. Avian Studies

Two studies show that formulated simazine is practically nontoxic to birds in acute dietary exposures. Beliles et al. (1965, 0043671) report an LC50 of >32,000 ppm and =11,000 for mallards and bobwhite quail, respectivley.

2. Aquatic Studies

Formulated simazine has been demonstrated to be slightly toxic to finfish with a 96-hr LC50 of 40.5 ppm to the rainbow trout (Kuc, 1976, 163136). A fathead minnow partial chronic test (Mayer and Sanders, 1975, 00043676) revealed a reduction in fry growth at 2.5 ppm but no observed effects to spawning, hatching, larval/fry growth and survival at 1.2 ppm.

A simulated field study (Gilderhus, 1967, 00025433) conducted in 0.01-acre concrete ponds demonstrated mortalities to bluegill at 5 ppm, and sublethal effects (behavioral and histopathological) occurred at single treatments of 2.5 ppm and above and at repeated treatments of 1 ppm (lowest rate tested) and above. The 2.5 ppm and 5 ppm treatments temporarily reduced benthic invertebrates after initial treatment.

II Uses

Simazine is a selective or non-selective, triazine herbicide used to control grasses, broadleaf, woody plants and algae. Simazine is formulated as a graular, soluble granular, emulsifiable concentrate, and wettable powder.

A Use Sites

Terrestrial, food uses include: citrus, corn, apples, blueberries, grapes, pastures, and walnuts.

Terrestrial, non-food uses include: turf, ornamentals, non-crop areas, rangeland, rights-of-way, Christmas tree plantations, forest nurseries, and forest plantings.

Aquatic, non-food use: ponds, swimming pools and cooling water.

Uses cancelled since the initial registration standard include alfalfa, drainage ditch banks, hay, grass grown for seed, tree plantations grown for timber and tree seedlings.

B Discussion of Uses

According to the Preliminary Quantitative Use Assessment, October, 1987, the primary usage of simazine is for corn (29%), aquatic (27%), alfalfa (10%), citrus (9%), grapes (4%) and apples (3%).

III Environmental Fate Information

Information presented in the original standard and presented here indicate that available data are insufficient to fully assess the environmental fate of simazine. Simazine is relatively persistent in soil (1/2-life reported from 10 to 40 days) with microbial action the primary degradation pathway. In water, simazine is very persistent (1/2-life reported up to 700 days in pond water). Simazine is stable to photolysis and is not considered to be bioaccumulative.

Simazine is absorbed by plant roots and is translocated to the stem and leaves. Within the plant cell, it inhibits photosynthesis. The greater the amount of vegetation, the faster simazine dissipates.

IV Hazard Assessment

A Discussion

The available information indicates that simazine is practically non-toxic to terrestrial wildlife and moderately toxic to aquatic organisms in acute exposures. Technical simazine is a moderate eye and dermal irritant (Toxicity Category III) and has low oral and dermal toxicities (Toxicity Category IV) in mammals. The chronic toxicity of simazine to terrestrial organisms is generally low based on the observations that reproduction is not impaired at 20 ppm or 100 ppm in mallards or bowhite quail, respectively. Slight impairment observed at 500 ppm in bobwhite quail provides evidence that a potential chronic concern is justified only at relatively high residues (> 100 ppm). For concentrations above 100 ppm, additional information on mallard reproduction is needed for an adequate assessment. With a fish chronic NOEL of 1.2 ppm and adverse effects to aquatic invertebrates observed at 1 ppm in a simulated field test, aquatic organisms are potentially at risk to chronic exposure of concentrations above 1 ppm.

Simazine is registered for numerous outdoor uses, including agricultural crops such as corn, and non-agricultural uses such as rights-of-way and ponds. Exposure to non-target organisms can result from residues of direct applications, spray drift from treated areas and runoff from treated areas. Such exposures would be both acute and chronic. Due to the absence of a complete set of environmental fate and non-target organism toxicity data, a full Ecological Effects Hazard Assessment cannot be completed at this time.

Agricultural uses have application rates typically up to 4 lbs. a.i./acre, although a few uses (e.g., citrus) allow rates up to 9.6 lbs. a.i./acre, and non-crop uses up to 40 lbs. a.i./acre.

TABLE 1 - Expected Residues (ppm)

Vegetation/Surface Type	Application Rate (a.i.) 1 lb.	4 lbs. maximum (typical)	9.6 lbs.	40 lbs.
Short grass	240(125)	960 (500)	2304(1200)	9600(5000)
Long grass	110(92)	440 (368)	1056(883)	4400(3680)
Leafy crops	125(35)	500 (140)	1200(336)	5000(1400)
Forage/Small Insects	58(33)	232 (132)	557(317)	2320(1320)
Seeds/Pods/Large Insects	12(3)	48 (12)	115(29)	480(120)
Fruit	7(1.5)	28 (6)	67(14)	280(60)
Soil (0.5 inches)	4.4		42	176
Water (0.5 feet)	0.7		7	29

TABLE 2 - Measured Simazine Residues on Various Crops

Crop	Rate lbs. a.i. per acre	Days after application	Residue (ppm)
Bermuda grass	2.4	30	≤ 13.00
	2.56	28	≤ 34.00
	4.0	60	≤ 0.23
	5.0	50	≤ 0.91
	16.0	90	≤ 0.70
Red Fescue & Perrennial ryegrass	3.0	29	1.19
	3.0	36	0.45
Alfalfa	1.6	23	11.00
	1.6	52	0.65
	2.0	14	17.00
	4.0	19	30.00

Measured residues indicate a cumulative half-life on vegetation of between 5 and 10 days. This rate includes dissipation and degradation rates. Initial residues will generally dissipate very rapidly moving off plant surfaces into the soil to be later translocated into the plant. It can be reasonably concluded from the above tables that at typical agricultural rates up to 4 lbs. a.i./acre initial rates on vegetation will be well below acutely toxic concentrations (LC50 > 5000 ppm) and will be below laboratory derived NOEC for bobwhite reproduction within 1 week on typical avian forage. The highest concentration tested for mallards was 20 ppm which showed no adverse effects, but additional data at higher test concentrations are needed to allow assessment of use rates greater than 1 lb. a.i./acre which will allow resiudes on waterfowl forage to exceed 20 ppm for greater than one week. Although rates above 4 lbs. a.i./acre are not expected to pose any acute risks to terrestrial organisms, concentrations which exceed the laboratory derived NOEC for bobwhite reproduction can be expected for several weeks after treatment. In considering chronic risks to birds, it must be understood that the laboratory derived LOEC of 500 ppm for bobwhite quail identifed only a minor, albeit significant, reduction in eggs laid. Also, non-crop uses which allow high rates of application generally involve treatment of areas with little or no vegetation as a pre-emergent control and vegetation treated at such high rates would also be destroyed. Therefore, forage at such sites would be very limited except in margin areas between treated and untreated sites.

With a half-life in pond water of up to 700 days, residues of simazine which reach aquatic environments will likely pose serious chronic risks at concentrations above 1 ppm. Agricultural uses, even at maximum rates of 9.6 lbs. a.i./acre, are not expected to allow contamination of aquatic environments to concentrations reaching 1 ppm. Specifically for 9.6 lbs. a.i./acre use,

Drift (5% from aerial) = 0.48 lbs. a.i./acre loading
in 6 inches of water = 352 ppb
in 6 feet of water = 29.4 ppb

Runoff (1% in 10-to-1 basin) = 0.96 lbs. a.i./acre loading
in 6 inches of water = 705 ppb
in 6 feet of water = 58.6 ppb.

These concentrations are below laboratory observed effect concentrations and are not expected to pose any direct acute or chronic risks to aquatic organisms. This conclusion is further supported by STORET data. Of 5849 surface water samples analyzed for simazine since 1966, 941 samples had detectable residues. One sample, taken 10-16-86 in California, was 1.3 ppm. Twenty samples revealed concentrations from 100 to 700 ppb. All other samples with detectable residues had concentrations generally below 30 ppb. This information, though not specifically targeting areas where simazine use or exposure potential is high, suggests that concentrations of simazine which could threaten aquatic fauna are predominately not exceeded and despite being persistent does not accumulate in the environment.

Non-crop uses (rights-of-way, forestry, etc.) with rates up to 40 lbs. a.i./acre will marginally exceed the 1 ppm critical level identified for aquatic organisms. In worst case scenarios, 20% of the aerially applied or even ground applied (primarily ditchbank uses only) simazine could reach aquatic environments. At maximum rates, this translates into water concentrations of 5.9 ppm in six inches of water and 0.49 ppm in six feet of water. Small streams and shallow ponds would be at risk. For most of these uses, ground cover would be at a minimum as recommended by the label. Without groundcover, areas treated with simazine would have a greater susceptibility for runoff loss than vegetated or cultivated areas. With this consideration, 5% runoff loss of simazine is not unrealistic in non-crop areas such as rights-of-way adjacent to aquatic habitat. A scenario of 5 treated acres for every acre-foot of adjacent water would yield water concentrations of 3.7 ppm. Uses which allow direct application to water (ponds, etc.) have rates of up to 3.4 lbs. a.i./acre-foot in ponds without drainage and 12 lbs. a.i./acre-foot in ponds with drainage. This would allow for concentrations of simazine in pond water to be 2.5 ppm in ponds without drainage and 8.8 ppm in ponds

with drainage. Both are likely to pose substantial risk to fish and invertebrates within the treated ponds, also for ponds with drainage receiving streams for such drainage could be at risk. Additional data (aquatic field testing) are needed to fully evaluate the potential direct and indirect effects to aquatic systems.

B Summary of Hazard

No adverse effects to non-target fish and wildlife are indicated for acute exposure to simazine at any application rate. Chronic risks to aquatic organisms and wildlife may occur at non-crop use rates. Aquatic organisms would also be at high risk from maximum aquatic use rates. Additional information is needed to assess potential risks from these chronic exposures and non-target plant exposures.

V Endangered Species

Because of its expected toxicity to non-target plant species (based on its label claims as a herbicide) and its intended use pattern, simazine has been identified by the Office of Endangered Species (OES), U. S. Fish and Wildlife Service (FWS), as being likely to jeopardize endangered species when used on forests and/or rangeland. Based on this determination, OES specified reasonable and prudent alternatives to avoid jeopardizing the continued existence of the identified species by these uses. EPA is working with the FWS and other Federal and State agencies to implement the alternatives in a technically sound manner.

In May 1987, EPA issued PR Notices 87-4 and 87-5 in response to OES findings that certain pesticides, including simazine, jeopardized the continued existence of endangered species. Those PR Notices directed registrants to add labeling to their products which referred users to additional information that, in turn, explained limitations on use of the pesticide within the range of jeopardized endangered species. Subsequent to issuance of these PR Notices, EPA identified a number of significant technical errors and inconsistencies in the information to which users would have been referred. Therefore, on January 26, 1988 the Agency issued PR Notice 88-1 which withdrew 87-4 and 87-5 pending development of a more focused program to protect endangered species.

EPA is working to correct these errors prior to requiring labeling to protect endangered species. When that program is fully developed, notice of any labeling necessary to protect endangered species will be issued.

VI Precautionary Labeling

A. Manufacturing Use

"Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans, or public waters unless this product is specifically identified and addressed in an NPDES permit. Do not discharge effluent containing this product to sewer systems without previously notifying the sewage treatment plant authority. For guidance, contact your State Water Board or Regional Office of the EPA."

B. End-Use Products

1. Non-aquatic use sites:

"Do not apply directly to water or wetlands (swamps, bogs, marshes, and potholes). Do not contaminate water when disposing of equipment washwaters."

2. Aquatic use sites:

"Do not contaminate or allow discharge into domestic, livestock, or irrigation water supplies, or lakes or streams. Do not contaminate water when disposing of equipment washwaters."

VII CLASSIFICATION

The available information warrants that simazine be classified for restricted use for all aquatic uses and all non-crop uses with application rates > 10 lbs. a.i./acre.

VIII DATA REQUIREMENTS

The required data are provided in Table A, attached.

TABLE A
Generic Data Requirements for SIMAZINE

Data Requirement	Composition[1/]	Use Pattern[2/]	Does EPA have data to satisfy this requirement? (Yes, No or Partially)	Bibliographic Citation	Must additional data be submitted under FIFRA Section 3(c)(2)(B)?
§158.145 Wildlife and Aquatic Organisms					
Avian and Mammalian Testing					
71-1 Avian Oral LD50	TGAI	A,B,D,G	Yes	72798	No
71-2 Avian Dietary LC50					
a-waterfowl	TGAI	A,B,D,G	Yes	00022923 ~~34796~~	No
b-upland game	TGAI	A,B,D,G	Yes	00022923 ~~34796~~, ~~70001~~ 00139393	No
71-3 Wild Mammal Toxicity	TGAI	A,B,D,G	No		No
71-4 Avian Reproduction	TGAI	A,B,D,G	Partially	43678, 163134	Yes[3/]
71-5 Simulated and Actual Field Testing - Mammals	TGAI	A,B,D,G	No		No[4/]
Aquatic Organism Testing					
72-1 Freshwater Fish LC50					
a-warmwater	TGAI	A,B,D,G	Yes	25438, 33309	No
	TEP	D,G	Yes	40098001	No
b-coldwater	TGAI	A,B,D,G	Yes	✓ 43666	No
	TEP	D,G	Yes	✓ 40245701	No
72-2 Freshwater Invertebrate Acute EC50	TGAI	A,B,D,G	Yes	40098001	No
	TEP	D,G	Yes	✓ 40098001, 43676	No

TABLE A (Continued)
Generic Data Requirements for SIMAZINE

Data Requirement	Composition[1/]	Use Pattern[2/]	Does EPA have data to satisfy this requirement? (Yes, No or Partially)	Bibliographic Citation	Must additional data be submitted under FIFRA Section 3(c)(2)(B)?
72-3 Estuarine/Marine Organism Acute EC50					
a-finfish	TGAI	A,B,D,G	No		Yes[5/]
b-crustacean	TGAI	A,B,D,G	Yes	23331	No
c-mollusc	TGAI	A,B,D,G	No		Yes[5/]
72-4 Fish Early-Life Stage and Aquatic Invertebrate Life-Cycle	TGAI	A,B,D,G	Yes	43668, 43676	No
72-5 Aquatic Organism Accumulation	TGAI	D,G	Partially	43668, 43670	No[6/]
72-6 Life-Cycle Tests with Fish	TGAI	A,B,D,G	Yes	43676	No
72-7 Simulated or Actual Field Testing - Aquatic	TEP	A,B,D,G	Partially	25433	Yes[7/]

TABLE A (Continued)
Generic Data Requirements for SIMAZINE

Data Requirement	Composition[1/]	Use Pattern[2/]	Does EPA have data to satisfy this requirement? (Yes, No or Partially)	Bibliographic Citation	Must additional data be submitted under FIFRA Section 3(c)(2)(B)?
§158.150 Plant Protection Testing					
Tier I:					
122-1 Seed Germination/Seedling Seedling Emergence	TGAI	B,D,G	No		No[8/]
Vegetative Vigor	TGAI	B,D,G	No		No[8/]
122-2 Aquatic Plant Growth	TGAI	B,D,G	No		No[8/]
Tier II:					
123-1 Seed Germination/Seedling Seedling Emergence	TGAI	B,D,G	No		Yes[9/]
Vegetative Vigor	TGAI	B,D,G	No		Yes[9/]
123-2 Aquatic Plant Growth	TGAI	B,D,G	No		Yes[9/]
Tier III:					
124-1 Terrestrial Field	TGAI	B,D,G	No		No[10/]
124-2 Aquatic Field	TGAI	B,D,G	No		No[10/]

1/ Composition: TGAI = Technical grade of the active ingredient; PAI = Pure active ingredient; TEP = Typical end-use product.
2/ The use patterns are coded as follows: A=Terrestrial, Food Crop; B=Terrestrial Non-Food Crop; C=Aquatic, Food Crop; D=Aquatic, Non-Food Crop; E=Greenhouse, Non-Food Crop; G=Forestry; H=Domestic Outdoor; I=Indoor.
3/ Avian reproduction testing with waterfowl, e.g., mallard duck, at test concentrations of 100, 500 and 2500 is needed to evaluate high expected exposures from simazine uses > 10 lbs. a.i. per acre.
4/ Reserved pending receipt of waterfowl reproduction requirements.
5/ Required for citrus, corn, rights-of-way, and turf.
6/ Available data insufficient to fulfill data requirement but are considered adequate to indicate a very low potential to bioaccumulate (BCF < 6x) and additional data requirements are waived.
7/ Hazard assessment for aquatic uses and high-rate terrestrial uses (e.g., >10 lbs. a.i./acre) indicated a high risk to aquatic organisms. A comprehensive aquatic field study to quantify direct and indirect effects on aquatic organisms if the hazard indicated by available laboratory and field evidence is ecologically significant. The EEB recommends that a protocol for conducting this study be submitted prior to initiation of the field work. A guidance document outlining acceptable methods for conducting an aquatic mesocosm test (Touart, 1988, NTIS) can be consulted in designing an appropriate comprehensive test. A mesocosm test is recommended because it is believed to be extrapolatable to the variety of simazine uses.
8/ These test are not required as simazine is registered for use as a herbicide.
9/ Required for all terrestrial non-food and aquatic uses.
10/ Higher tier testing is reserved pending receipt of the lower tier tests.

1/ Composition: TGAI = Technical grade of the active ingredient; PAI = Pure active ingredient; TEP = Typical end-use product.
2/ The use patterns are coded as follows: A=Terrestrial, Food Crop; B=Terrestrial Non-Food Crop; C=Aquatic, Food Crop; D=Aquatic, Non-Food Crop; E=Greenhouse, Non-Food Crop; G=Forestry; H=Domestic Outdoor; I=Indoor.
3/ Avian reproduction testing with waterfowl, e.g., mallard duck, at test concentrations of 100, 500 and 2500 is needed to evaluate high expected exposures from simazine uses > 10 lbs. a.i. per acre.
4/ Reserved pending receipt of waterfowl reproduction requirements.
5/ Required for citrus, corn, rights-of-way, and turf.
6/ Available data insufficient to fulfill data requirement but are considered adequate to indicate a very low potential to bioaccumulate (BCF < 6x) and additional data requirements are waived.
7/ Hazard assessment for aquatic uses and high-rate terrestrial uses (e.g., >10 lbs. a.i./acre) indicated a high risk to aquatic organisms. A comprehensive aquatic field study to quantify direct and indirect effects on aquatic organisms if the hazard indicated by available laboratory and field evidence is ecologically significant. The EEB recommends that a protocol for conducting this study be submitted prior to initiation of the field work. A guidance document outlining acceptable methods for conducting an aquatic mesocosm test (Touart, 1988, NTIS) can be consulted in designing an appropriate comprehensive test. A mesocosm test is recommended because it is believed to be extrapolatable to the variety of simazine uses.
8/ These test are not required as simazine is registered for use as a herbicide.
9/ Required for all terrestrial non-food and aquatic uses.
10/ Higher tier testing is reserved pending receipt of the lower tier tests.